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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/458,581	12/09/1999	MUSTAFA PINARBASI	SA998141	9016

7590 06/24/2003

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EXAMINER	
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ART UNIT	PAPER NUMBER
1753	17

DATE MAILED: 06/24/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

PTO-90C (Rev. 07-01)

Office Action Summary	Application No. 09/458,581	Applicant(s) Pinarbasi
	Examiner Rodney McDonald	Art Unit 1753

-- *The MAILING DATE of this communication appears on the cover sheet with the correspondence address* --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136 (a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1) ☒ Responsive to communication(s) filed on *Apr 14, 2003*.

2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.

3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11; 453 O.G. 213.

Disposition of Claims

4) ☒ Claim(s) *32, 34, 36-42, 44, 46, 48, 49, 51, 53, and 55-90* is/are pending in the application.

4a) Of the above, claim(s) ______ is/are withdrawn from consideration.

5) ☒ Claim(s) *32, 34, 36-42, 44, 46, 48, 49, 51, 53, and 71-73* is/are allowed.

6) ☒ Claim(s) *55, 59, 63, 68-70, 74, 75, 79, and 83* is/are rejected.

7) ☒ Claim(s) *56-58, 60-62, 64-67, 76-78, 80-82, and 84-90* is/are objected to.

8) ☐ Claims ______ are subject to restriction and/or election requirement.

Application Papers

9) ☐ The specification is objected to by the Examiner.

10) ☐ The drawing(s) filed on ______ is/are a) ☐ accepted or b) ☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11) ☐ The proposed drawing correction filed on ______ is: a) ☐ approved b) ☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13) ☐ Acknowledgement is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a) ☐ All b) ☐ Some* c) ☐ None of:

1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. ______.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

*See the attached detailed Office action for a list of the certified copies not received.

14) ☐ Acknowledgement is made of a claim for domestic priority under 35 U.S.C. § 119(e).

a) ☐ The translation of the foreign language provisional application has been received.

15) ☐ Acknowledgement is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s). ______

4) ☐ Interview Summary (PTO-413) Paper No(s). ______

5) ☐ Notice of Informal Patent Application (PTO-152)

6) ☐ Other:

DETAILED ACTION

Drawings

1. The new drawings are approved by the Examiner.

Claim Rejections - 35 USC § 112

2. Claims 68-70 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claim 68 is indefinite because the angle β of 0 ° is outside the range of an angle β which is from 10 to 30 °.

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

4. Claims 55, 59 and 63 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lin (U.S. Pat. 5,768,071) in view of Pinarbasi (U.S. Pat. 5,492,605) and Fujikata et al. (U.S. Pat. 5,766,743).

Lin teach a spin valve sensor shown in FIGS. 8 and 9 has a ferromagnetic free layer 110, a nonmagnetic electrically conductive spacer layer 114, and a pinned ferromagnetic layer 112. A capping layer 127, such as Ta or other commonly used protective material, may cover the free layer 110. A ferromagnetic flux keeper layer may be employed in another embodiment, and may

be comprised of materials such as NiFe, NiFeCr, NiFeRh, NiFeNb, or any other alloy having similar performance capabilities. The flux keeper layer preferably covers the capping layer 127. The spacer layer 114 is sandwiched between the free layer 110 and the pinned layer 112. In one embodiment, a ferromagnetic Co layer may be sandwiched between either the free layer 110 and the spacer layer 114, or between the pinned layer 112 and the spacer layer 114. The antiferromagnetic layer 122 abuts the nonmagnetic intermediate layer 116 and pins the magnetization 124 of the pinned layer 112 in a direction perpendicular to the ABS. The nonmagnetic intermediate layer 116 may be very thin, in the order of 0.5 nm, continuous or discontinuous, and does not significantly impede the antiferromagnetic exchange coupling between the antiferromagnetic layer 122 and the pinned layer 112. (Column 5 lines 26-47)

FIG. 10 shows a simplified illustration of the spin valve sensor 53a shown in FIGS. 8 and 9. The illustration generally indicates the relative physical orientation of each layer used in one embodiment of the current invention. The antiferromagnetic layer 1010 may be considerably thicker than any of the other layers, which include a discontinuous intermediate layer 1007, ferromagnetic layers 1008 and 1006, a spacer layer 1004, a free layer 1003, and a protective top layer 1002. Although each of the layers may be comprised of a suitable material well known to one skilled in the art, the layers preferably comprise a Cu intermediate later 1007, a NiFe layer 1008, a Co layer 1006, a NiFe free layer 1003, a Ta protective layer 1002, a Cu spacer layer 1004, and a NiO antiferromagnetic layer 1010. (Column 6 lines 22-36)

Exemplary materials for the spin valve sensors 53a and 53b are NiFe for the free layer 110, Cu for the spacer layer 114, Co, NiFe, NiFe/Co for the pinned layer 112, Cu for the intermediate layer 116, and Ta for the capping layer 127. NiO is preferred for the

antiferromagnetic pinning layer 122, although other materials interacting similarly with the nonmagnetic layer 116 and the pinning layer 112, as well as spacer layer 114 and the free layer 110, may be used. For example, cobalt oxide, nickel oxide, iron oxide, iron sulfide, iron manganese, or oxide solutions thereof, amongst others, may suffice. The intermediate layer 116 may alternatively comprise Au, Ag, or other nonferromeagnetic material having high conductivity. (Column 8 lines 5-17)

The differences between Lin and the present claim is that oblique sputtering is not discussed, the angles involved in the oblique sputtering are not discussed and utilizing two layers for the pinning layer structure is not discussed.

Pinarbasi et al. teach an ion beam sputter deposition system and method for fabrication of multilayered thin film structures. Selected combinations of ion beam gases and energies matched to the selected target materials optimize the physical, magnetic and electrical properties of the deposited thin film layers. (See Abstract)

Referring now also to FIG. 2, a simplified block diagram illustrating an ion beam sputter deposition system constructed in accordance with the principles of the present invention is shown. The ion beam sputter deposition system 20 includes a vacuum chamber 22 in which an ion beam source 21 is mounted, a target 23 and a workpiece or deposition substrate 51. An ion beam 33 provided by the ion source 21 is directed at the target 23 where the impacting ions cause sputtering of the target material, Selectable, multiple targets 23 may be provided on a rotary target support 25. The sputtered atoms 26 emitted by the target material are directed onto a deposition substrate 31 on which is formed a layer of the target material. A thickness monitor positioned closely adjacent the substrate to provide real-time, in-situ monitoring of the thickness

of the growing film during deposition. ***The substrate or other workpiece 51 is mounted on a movable pedestal or support member 41*** which is retrieved into a loading port 39 via a gate valve; 38 for changing the workpiece 51. The pedestal 41 may also be temperature controlled, i.e., heated or cooled or both. ***A magnetic field may also be applied at the workpiece 31 if required for the particular structure being deposited.*** The pedestal 41 may also be rotated by means of a linear/rotary motor drive (not shown). During operation, the vacuum chamber is maintained at an internal operation pressure on the order of 1.times.10.sup.-4 Torr by a vacuum pump (not shown) via port 35. (Column 4 lines 45-68; Column 5 lines 1-4)

In order to provide practical magnetoresistive (MR) read sensors for use in magnetic recording devices, it is desirable to optimize as much as possible the MR and magnetic properties of the materials, such as ***NiFe***, for example, utilized for the MR element in the sensor structure. In the prior art, DC or magnetron sputter deposition, for example, it is critical to use a Ta underlayer with a NiFe layer to achieve sufficient MR response for MR sensor applications. In contrast, ion beam deposited NiFe films, both with and without Ta underlayers exhibit nearly identical values of MR and other magnetic properties. Eliminating the Ta underlayer dependence provides many more options and alternatives when designing an MR sensor. The characterization of the NiFe films included the measurement of electrical resistance (R), the change in R under an applied magnetic field (dR).and the ratio dR/R as well as the coercivity and anisotropy field (H.sub.k) of the film. NiFe films were deposited both with a Ta underlayer and directly on glass substrates. The bilayer structures (NiFe/Ta) having 50 and 100 A NiFe films show a lower magnetoresistance compared to the NiFe films deposited directly on glass substrates because the Ta underlayer carries a significant portion of the measuring current. For NiFe layers greater than 250 .ANG.

thickness, the Ta underlayer no longer contributes to this effect. These films exhibited a relatively low H.sub.c, H.sub.k and sheet resistance while having a relatively good magnetoresistance.Magnetostriction measurements showed a value of 0.25.times.10.sup.-6 for a 267 .ANG. thick NiFe film. (Column 8 lines 18-48)

Soft magnetic films of ***nickel-iron-rhodium (NiFeRh)*** were also deposited using ion beam deposition and the electrical and magnetic properties evaluated. The NiFeRh films exhibited relatively good magnetoresistance and sheet resistance. The magnetoresistance of a 100 A thick NiFeRh film was measured to be only 0.192 Ohms/square while the sheet resistance was found to be 43.5 Ohms/square. Magnetostriction measurements showed a value of 0.13.times.10.sup.-6 for the 100 ANG thick NiFeRh film. (Column 8 lines 49-58)

Referring now also to FIG. 7, a trilayer MR structure comprising a soft magnetic layer 76, a spacer layer 74 and an MR layer 72 is formed on substrate 78 by ion beam deposition as described above. The magnetic and electrical properties of an ion beam sputtered trilayer structure 70 comprising a thin film soft magnetic layer of NiFeRh 76, a thin film spacer layer of Ta and a thin film MR layer of NiFe deposited on substrate 78 was analyzed for various combinations of layers of different thicknesses. (Column 9 lines 33-42)

Referring now also to FIGS. 8a and 8b, FIG. 8a illustrates an MR sensor 80 of the type described in U.S. Pat. No. 5,014,147 comprising a multilayer MR structure 80 having a soft magnetic layer 77, a spacer layer 79, an MR layer 82 and a longitudinal bias layer 84 deposited on a substrate 75. Conductor leads 92 deposited over the end regions of the longitudinal bias layer 84 provide electrical connection of the MR sensor to external circuitry (not shown). (Column 10 lines 16-24)

In a preferred embodiment, a multilayer MR sensor, such as MR sensors 80, 90, fabricated utilizing ion beam deposition techniques as described hereinbelow, comprises a soft magnetic layer 77 of NiFeRh, a spacer layer 79 of Ta and an MR layer 82 of NiFe deposited on a substrate 75. The longitudinal bias layer 84 is a hard bias layer, as is well known in the art, such as a layer of ***CoPtCr, CoCr or CoPt*** deposited in end regions of the MR layer 82 as described in U.S. Pat. No. 5,018,057 to Krounbi et al. (Column 10 lines 38-47)

For soft magnetic layer 77, NiFeRh or NiFeCr or other suitable soft magnetic material may be used. For the MR layer 82, ferromagnetic materials such as ***Ni, Fe, Co and alloys thereof***, NiFe and NiFeCo, for example, or other suitable materials may be used. For the spacer layer 79, tantalum (hcp phase), ***Al.sub.2 O.sub.3, SiO.sub.2 and oxide compounds of tantalum***, such as Ta.sub.2 O.sub.5, can be used. Materials, such as Ta, having a suitable crystalline structure which promotes the desired MR layer 82 growth are preferable for the spacer layer 79. (Column 10 lines 57-68)

The primary ion source comprises a 12 cm Kaufman ion source adjustably mounted to provide a variable angle of incidence of the ion beam on the target 91 over a range of 0 degrees, i.e., normal to the target, to about 60 degrees. (Column 12 lines 46-49) ***Oblique sputtering occurs in the range of 0 to 60 degrees. Since Pinarbasi teach an angle of 0 to 60 degrees which is representative of the α angle and suggest no ranges of other angles it is believed that such "no suggestion" of other angles must include a β angle of 0 degrees. Since a β angle of 0 degrees can exist in a plane perpendicular to the plane containing the α angle it is believed this suggests Applicant's claim limitation. It should be noted that Applicant's β angle can be 0 degrees.***

The motivation for obliquely sputtering is that it allows reduction in the internal stress of the deposited film and multilayer structures. (Column 2 lines 27-30)

Fujikata et al. teach utilizing an antiferromagnetic thin film comprised of a two-layer structure composed of a CoO layer deposited on a NiO layer. (See Abstract) As the additional antiferromagnetic layer for stabilization of the magnetic domains, those materials such as FeMn, NiMn, NiO, CoO, Fe2O3, FeO, CrO, and MnO are preferred. (Column 6 lines 2-5)

The motivation for utilizing a two layer structure is that it allows for avoiding Barkhausen jumps. (Column 6 line 1)

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have modified Lin by obliquely sputtering as taught by Pinarbasi and to have utilized a two layer structure as taught by Fujikata et al. because it allows for reducing the internal stress of the deposited film and multilayer structures and allows for avoiding Barkhausen jumps.

5. Claims 74 and 75 are rejected under 35 U.S.C. 103(a) as being unpatentable over Pinarbasi (U.S. Pat. 5,492,605).

Pinarbasi is discussed above and all is as applies above. (See Pinarbasi discussed above)

The differences between Pinarbasi and the present claims is the planes orthogonal containing the alpha and beta angles.

Since Pinarbasi teach an angle of 0 to 60 degrees which is representative of the α angle and suggest no ranges of other angles it is believed that such "no suggestion" of other angles must include a β angle of 0 degrees. Since a β angle of 0 degrees can exist in a plane perpendicular to the plane containing the α angle it is believed this suggests Applicant's claim limitation. It should

be noted that Applicant's β angle can be 0 degrees.

The motivation for obliquely sputtering is that it allows reduction in the internal stress of the deposited film and multilayer structures. (Column 2 lines 27-30)

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have oblique sputtered in the forming of a device as taught by Pinarbasi because it allows for reduction in the internal stress of the deposited film and multilayer structures.

6. Claims 79 and 83 are rejected under 35 U.S.C. 103(a) as being unpatentable over Pinarbasi as applied to claims 74 and 75 above, and further in view of Lin (U.S. Pat. 5,768,071).

The differences not yet discussed is the formation of a spin valve sensor.

Lin teach forming a spin valve sensor and is discussed above. (See Lin discussed above)

The motivation for forming a spin valve sensor is that it allows for reading magnetic media. (Column 1 lines 12-14)

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have formed a spin valve sensor as taught by Lin because it allows for the reading of magnetic media.

Allowable Subject Matter

7. Claims 32, 34, 36-42, 44, 46, 48, 49, 51, 53, 71, 72, 73 are allowed.

8. Claims 56-58, 60-62, 64-67, 76-78, 80-82 and 84-90 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

9. Claims 32, 36-39, 41, 42, 44, 46, 48, 49, 51, 53, 56-58, 61, 62, 64-67, 71-73, 76-78, 81,

82 and 84-90 are indicated as being allowable because the prior art of record does not teach the oblique ion beam sputtering utilizing the disclosed angles.

10. Claims 34, 40, 60 and 80 are indicated as being allowable because the prior art of record does not teach oblique ion beam sputtering to form the alpha iron oxide combined with the formed structure.

Response to Arguments

16. Applicant's arguments filed April 14, 2003 have been fully considered but they are not persuasive.

The objections to the drawings have been overcome. The objection to the specification has been overcome. The 35 U.S.C. 112 first paragraph rejections have been overcome. The 35 U.S.C. 112 2nd paragraph rejections have been overcome. A new 35 U.S.C. 112 2nd paragraph rejection has been made.

RESPONSE TO ARGUMENTS:

The remaining argument is whether the angle of β can be interpreteted as including the angle 0 °. Applicant argues that since the claims have been amended to indicate that the angles form planes this would exclude the use of an angle β equal to 0 °. The Examiner argues that the angle β can include 0 ° since this is a recognized geometric measurement of an angle. Furthermore, the Examiner points out that Applicant recognizes and claims that the angle β can equal 0 °. This is specifically shown in Applicant's claims for example see claim 83. Therefore the Examiner asserts that Pinarbasi teach an angle of 0 to 60 degrees which is representative of the α angle and suggest no ranges of other angles and it is believed that such "no suggestion" of other angles must include a β angle of 0 degrees. Since a β angle of 0 degrees can exist in a plane

perpendicular to the plane containing the α angle it is believed this suggests Applicant's claim limitation.

This action will be made NON-Final based on the new 35 U.S.C. 112 2nd paragraph rejection.

11. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Rodney McDonald whose telephone number is 703-308-3807. The examiner can normally be reached on M-Th from 8 to 5:30. The examiner can also be reached on alternate Fridays.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nam X. Nguyen, can be reached on (703) 308-3324. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9310.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0661.

RM

June 23, 2003

RODNEY G. MCDONALD
PRIMARY EXAMINER